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招待論文

# Utilizing Real-time Interactivity when teaching on Video Networks

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The paper discusses the experience gained using a videoconferencing network for real-time interactive teaching of surgery, with particular reference to the viewpoint of the teachers and students. The paper discusses the issues involved in encouraging interactivity between teachers and students, both locally and at remote sites, and y how the students' reluctance to speak out was overcome. The paper discusses applications in other domain areas and how this technique might develop in the light of more widespread broadband facilities and the recent developments in IPv6 and desktop video

**Keywords**
ICT－Information and Communications Technology, Video teaching networks, Undergraduate medical teaching, ISDN, Internet

## Aim

The aim of an educational technologist is to design an effective teaching and learning application using a particular technology. The choice of technology and the way it is used in an application should improve the teaching and learning environment, for example to make it possible for remote students to take part, to increase the number of students who can take part or to share scarce educational resources. Much work has been concerned with experimenting with ICT (Information and Communications Technology) systems that will transmit data necessary to display video and audio information as in videoconferencing, and facilitate real-time discussion and interaction. Experience has shown that although this technology has been around for some years providing a commercial conferencing service, its application in teaching and learning is not simple and there are many issues that are not yet fully understood, especially in real-time sessions. The most difficult problem is how to set up an interactive dialogue between tutor and students or between the students themselves, especially when the students are at different sites and are not likely to be known to each other except in the remote sessions.

## User Viewpoint

This discussion looks at this problem

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from the viewpoint of the users, both tutors and students. The paper describes the experience in UK of the delivery of a set of lectures in the undergraduate teaching of surgery to a consortium of six major medical schools in Scotland and England.[1] The project could be described as supplementing the familiar face-to-face lectures and tutorials by another face-to-face regime where videoconferencing technology was used to allow the students to be taught at a distance. The project was divided into three phases. The first consisted of establishing the network and testing the technology; for example, the broadband network used to pass audio and video signals between the six sites. The second stage was concerned with familiarising the tutors with the network and how it worked, and teaching them how to use the interactive facilities. The third stage involved learning from the experience of the second stage, and applying this knowledge to try to improve the educational experience for the students.

The principal problem for the technology is that if the communications link is broken the lecture stops for the students. In the early days these links did fail and it was essential to have technical staff on hand to restore the links. Even if this could be done in a few minutes the continuity of the lecture had been broken. Now the reliability of the video and audio links is much better and a failed connection is a rarity. Normally greater problems are experienced where the rooms for teaching are used by different groups and the equipment is tampered with and the settings are not correct when the system is required for teaching.

## Objective

The objective was to establish an interactive teaching network sharing the clinical material resources of a group of medical schools distributed throughout UK. This was particularly pertinent because changes in patient treatment by hospitals have cut down on patient hospital stays ,and this means there is less clinical material for teaching medical students. The University Medical Schools that belonged to the consortium were Cambridge, Newcastle, Edinburgh, Manchester, Bristol and University College London, which included 30 percent of all medical students studying in U.K. An important feature of this network was that all sites had the same facilities and so lectures could be delivered from any of the sites. Further an image server was available which could be controlled by any site and the images called up could be displayed over the whole network. This server was able to handle both still and moving images.

The network used ISDN technology at 2 Mbps, carried over an ATM network. There was little advantage in using 2 Mbps ISDN, as the resolution of the images was only marginally better than 660 Kbps videoconferencing systems. The technology used to run the network was not a critical matter—the important characteristic of the network was the time delay between asking a question and hearing the answer. As long as this remains less than a second the performance of the technology is not a fundamental issue.

## Organising Multiple Sites

The first major organisational problem

was to synchronise the teaching programme timetables so that the students in the different universities were available at the same time to receive lectures. At first the individual colleges were reluctant to change their timetables, but once they had exchanged lectures in the collaborative environment their willingness to make adjustments was much greater.

## Common Curriculum

The other potential problem was the curriculum. Fortunately in UK, the basic medical curriculum is set by the General Medical Council, and is the same for all medical schools. A particular medical school is permitted to add to this basic curriculum as they please. In other subjects areas this would probably have been a much greater problem, as a core curriculum is not specified in many subjects, and universities in UK are free to teach what they think is appropriate.

The teachers in the consortium were able to arrange between themselves that lectures on different topics were shared equally between the different centres and in this way the lectures reflected the specialities at the different centres.

## Lecturing to Camera

Most teachers were not familiar with lecturing to a camera, or with the greater part of the audience at remote sites. It was decided at the beginning of the second stage of the project that the lecturers would deliver their lectures in the same way as they had been doing for face-to-face teaching. This format was to deliver a one-hour lecture, the lecturer speaking and showing audio-visual aids for 55 minutes and in the last 5 minutes answering any questions from the student audience. Usually there were very few or no questions. Some lecturers would permit the students to interrupt while they were speaking, whilst others preferred questions at the end. On rare occasions a patient might be brought into the lecture theatre to demonstrate a clinical situation.

The teachers found to this form of teaching to the camera difficult as the experience of communicating with the remote students visible on the television screen was not as natural as talking with people in the same room. Also the students were reluctant to ask questions in front of strangers so the lectures became very formal, and became mainly a vehicle by which information was transferred in one direction from teacher to student without any discussion or criticism. The students quickly became unhappy and the number attending the lectures diminished. The fact that students did not ask questions is perhaps not so strange to a Japanese audience, but the students drifting away from lectures is not a common feature. However, students in Western universities show their displeasure and dissatisfaction with a lecture course by not attending.

## Interaction

Therefore the main problem for the project teachers was finding ways to improve the interaction between teacher and student in a real-time environment. If this resulted in students also interacting with each other in the periods before and after the lecture then that was a bonus.

Several methods were tried to encourage students to ask questions of the lecturer. Attempts were made to point out a specific student or to address the students by name from a list of those who should be attending the course. These methods did not work because there was too much opportunity for confusion and this interrupted the flow of the teaching. The solution that worked most effectively was for the students at each centre to choose one of their group to be their spokesperson. This person acted to receive the questions directed to them from the teacher and to return the answers, and also to initiate questions to the teacher if the students had problems.

The teachers normally stated they were directing a question at a specific group and in this way avoided the possibility of confusion as to who was being addressed. The questions were designed to be answered by the group after brief deliberation. This method was successful because it gave anonymity to the student who had originated a question or given the answer, as they could not be identified directly. The teachers also encouraged the students to interrupt the lecture and to ask questions, although in general the more junior students were reluctant to do so.

More recently, audience participation techniques have been used, especially with relatively large audiences. Each member of the audience has an infrared handset and can respond to questions posed by the lecturer. Each response is assessed by a computer system and the total answers displayed on a screen to all the audience. This technique does however require the questions to be designed to require yes/no answers, but complex answers can be built up from a sequence of questions.

## Feedback from students

In Western universities it is common to seek the opinion of students concerning their courses as a method of finding out the effectiveness of teaching and learning procedures. In the past it was considered a privilege to attend university and students rarely complained in public, but now the position has changed and the student is a customer, a user of services, which he/she pays for. The students were given a questionnaire to obtain their opinions about lectures being delivered over the network and what features, in their opinion, would make the lectures more interesting. The main student response was that they wished to see patients presented more frequently in the lectures to demonstrate the clinical phenomena. Also they felt that multimedia was not being used enough and the presentation of lectures and teaching could be made more visual and more interesting. This is not unreasonable because the teaching of medicine requires a large amount of visual material.

The teachers from the consortium of universities met for a working weekend to discuss the student responses and to consider the practical implications. The request to include patients' demonstrations in lectures was considered a positive idea and the extra workload to organise this was considered worthwhile. This was not a new request, but the teachers felt it would be particularly beneficial, as part of the reason for doing these lectures over a network was to overcome the shortage of clinical material available for teaching. These demonstrations were similar to

short clinical case presentations that were normally held later in the course. Introducing patients into the lectures caused some technical complications, as an additional video camera and lighting was required to transmit the patient examination over the network to the remote sites. The provision of the better quality visual aids and multimedia materials was not a technical problem, but it did involve the teachers in looking at their teaching material and making revisions as appropriate.

## Using Internet Connections

One of the limitations of videoconferencing systems is the inherent restriction on the resolution of the images due to the number of lines in the video image. This can be a serious problem in medicine, amongst other subjects, where high-resolution images are essential, e.g. in pathology. If the high-resolution images are produced in PowerPoint and transmitted over the Internet, the videoconferencing link can be used for audio and visual interaction. The time delay in transmitting images over the Internet was never a serious problem. The essential factor is that the teacher should be seen and heard by the students, adequately over the videoconferencing system.

## Video Streaming

It is possible to incorporate video images into the lecture space by video streaming over the college internal network using MPEG-1 and MPEG-2 technology. Lectures were recorded and made available on a server for the students whenever they wished to have access. The main advantage of this facility is for revision. One unexpected advantage was that the teaching staff had an opportunity to see how their lectures looked to the students and as a result some teachers put in more effort to improve their visual aids. When they saw the recorded lectures they became fully aware of the low quality of some of their slides, especially when transmitted across the network.

## System Design

The experience of taking part in this collaborative project demonstrated that the collaboration between teachers, technologists and teaching material designers could be extremely effective, in meeting the educational requirements stated by the academic staff. It showed that multi-disciplinary teams could work effectively together, respecting each other's primary skills and disciplines. At the same time the exchange of ideas amongst the group helped solve both organisational and technical problems, that had arisen.

**Table1. Student evaluations for network teaching**

| | |
|---|---|
| · Students happy to be taught over a network | 50-55% |
| · Students prepared to be taught over a network but preferring face-to-face teaching | 40-45% |
| · Students objecting to network teaching | 5-10% |

## Student Reaction

Over the past 5-6 years the student reaction to this type of remote teaching has been tested, and the results are consistent. From the first time the students are subjected to real-time network teaching the results each time have been as shown in Table1.

In the case of students who are taught over a network where this form of teaching has been continued for a number of semesters, the level of acceptance by the students improves. There was some resentment by the students that they were used to test a course being delivered remotely, but this cannot be completely avoided if a department is concerned with finding ways to improve its teaching and learning practices.

The fact that the students accept a course more easily when it has been delivered over the network a number of times is attributed to the teachers being more relaxed and familiar with the technology. Teachers have commented that they do require technician support that is immediately available so that if there is a technical problem it can be resolved very quickly. Our experience is that the reliability of videoconferencing and network technology has now improved sufficiently that when technical problems do arise they usually have been caused by human error. Further it has been found to be beneficial for teachers to have training on the "dos and don'ts" of teaching in front of a camera, and to receive advice on how to prepare their slides and PowerPoint presentations, for example, font sizes and colour combinations which make the presentation easy to view.

## Network Teaching Applications at University College London

In an addition to the intercollegiate course described in this discussion, there are other courses using this technology given in the same institution. As students with University College School of Medicine are distributed on three campuses, this technology solution is used so that the students in surgery taking the same curriculum can share the same lectures. An additional advantage is that there is a significant saving of staff time, which allows teaching staff to continue their research.

In the Department of Astro-physics this technology has been used as the teachers work at a research laboratory 50 kilometres away from the main campus where the students are situated. It is now possible for the researchers to stay at their laboratory and give their lectures thus saving most of a day travelling to and from London. The technology used is the combination of the Internet connection, used for the high-resolution images that are essential in this course, and the videoconferencing system to see and hear the teacher. An additional feature is a remote camera in the lecture room that is controlled by the teacher. This makes it possible for the teacher to see students in all parts of the room as required.

The students were happier about attending remote lectures when they themselves understood better what the technology was capable of doing. Students were worried that they could not discuss points at the end of the lecture with the teacher personally, but it is easy to use the network to discuss a point and draw diagrams. In fact it is possible to hold tutorials over

the network and this is done from time to time. In practice it has been found that a half lecture at the beginning of a course demonstrating the network and its functionality to the student has greatly increased its acceptance.

Another application has been set up to link a small consortium of European medical schools. The regulations within the European Community are that when a medical student qualifies, they are allowed to practice medicine anywhere within the European Community, irrespective of their nationality. However medicine is practiced differently among the EU countries and different service support structures exist to help the patient in each country. Little is taught in European medical schools about these different ways of practising medicine and so a small project was set up for clinical students to become aware of them. The ISDN facilities were used to link clinical students in 3 countries, U.K., Denmark and Finland, and medical students under the supervision of a hospital consultant presented clinical case studies. The organisation of these presentations gave rise to much the same problems as have been described earlier in this article. The student reaction was favourable, particularly as these case studies were usually given to students in small groups and so discussion between students and teachers was good.

## Asynchronous access to Web-sites

Additional work has been carried out providing the students with asynchronous access to web sites with additional information about the topics being covered in their lectures. Also video streaming facilities are available for the student to view lectures they have missed or for revision purposes. This combination of a synchronous and asynchronous learning environment offers high flexibility and can be used successfully for campus learning as well as distance learning.

## Future Developments

Some people believe that videoconferencing has not been a successful application of technology in education and that it has been mostly used by administrators in the conventional manner to assist meetings between people who are working on remote sites. However, in Japan teachers are interested in the use of moving images and broadband networks are becoming available. Further IPv6 software offers opportunities to work from the desktop so it is possible that videoconferencing will continue as a useful tool for teaching and learning at a distance, but the environment will change from the formal videoconferencing suite to the more informal environment at the desktop. This will still facilitate the tutorials and discussion and be particularly useful for small group in the more advanced studies in Higher Education. The overriding consideration is that as the higher bandwidth becomes available in the ICT environment people are likely to move from the text-based facilities to graphic facilities and eventually, as the technology develops, to moving images.

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